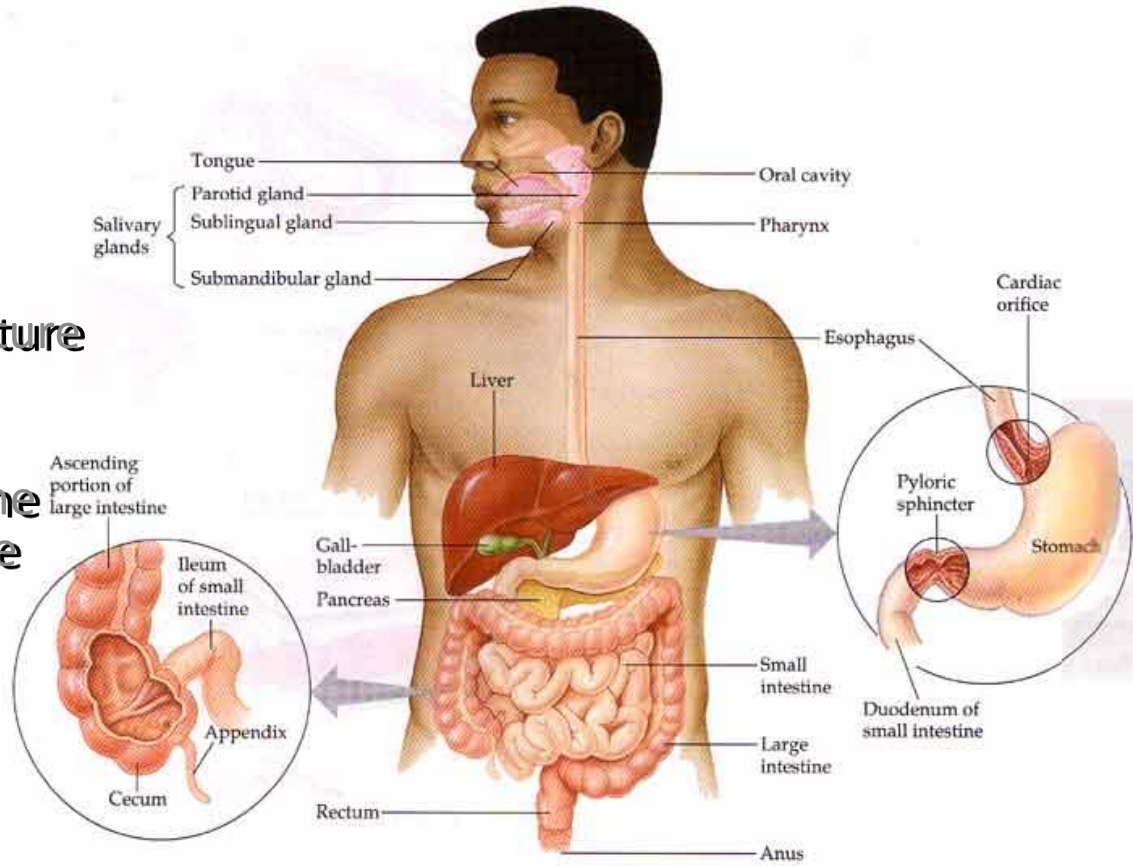
Digestive System, Part 1

Objectives:

Discuss the general functions and anatomy of the **digestive tract**, including accessory structures.

First, an overview of the tubular nature of the digestive system.

Describe the **individual organs** of the system, including a discussion of the gross and microscopic anatomy.



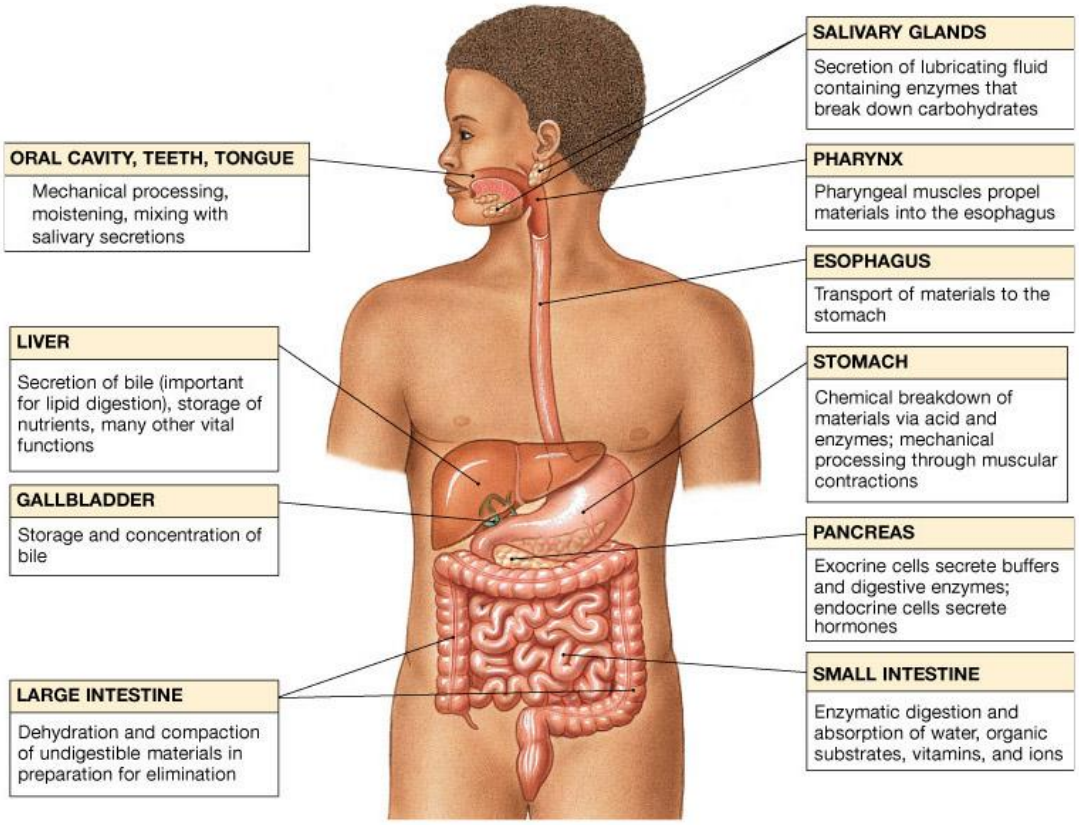
Developed by
John Gallagher, MS, DVM

LAS POSITAS COLLEGE

Digestive System Overview

AKA:
Digestive Tract
Alimentary Tract or Canal
GI tract
Gut

Muscular, hollow tube, from the lips to the anus
+
Various accessory organs

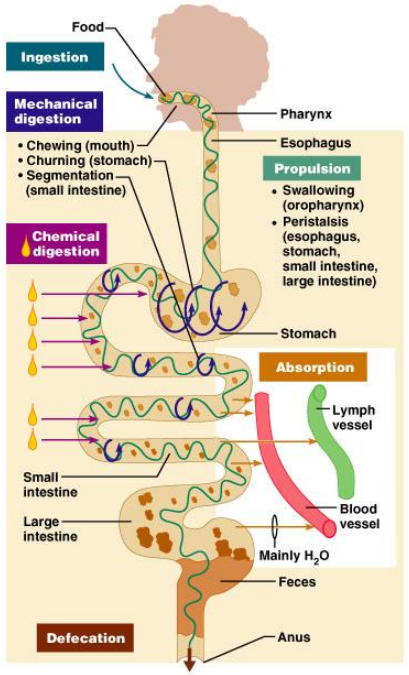

SALIVARY GLANDS
Secretion of lubricating fluid containing enzymes that break down carbohydrates
ORAL CAVITY, TEETH, TONGUE
Mechanical processing, moistening, mixing with salivary secretions
PHARYNX
Pharyngeal muscles propel materials into the esophagus
ESOPHAGUS
Transport of materials to the stomach
LIVER
Secretion of bile (important for lipid digestion), storage of nutrients, many other vital functions
STOMACH
Chemical breakdown of materials via acid and enzymes; mechanical processing through muscular contractions
GALLBLADDER
Storage and concentration of bile
PANCREAS
Exocrine cells secrete buffers and digestive enzymes; endocrine cells secrete hormones
LARGE INTESTINE
Dehydration and compaction of undigestible materials in preparation for elimination
SMALL INTESTINE
Enzymatic digestion and absorption of water, organic substrates, vitamins, and ions

Digestive System Overview

The function of the system as a whole is processing food in such a way that nutrients can be absorbed and residues eliminated.

Individual parts function in:

- Ingestion
- Propulsion
- Mechanical digestion and segmentation
- Chemical and enzymatic digestion
- Secretion
- Absorption
- Compaction
- Excretion and elimination (defecation)



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Membranes

Peritoneum - generic serous membrane in abdominal cavity
Parietal and Visceral Peritoneum
Retroperitoneal vs. (intra)peritoneal

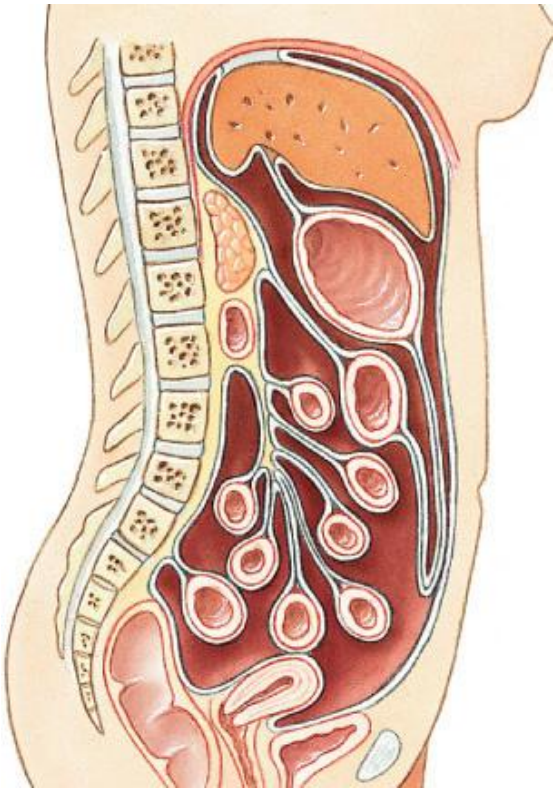
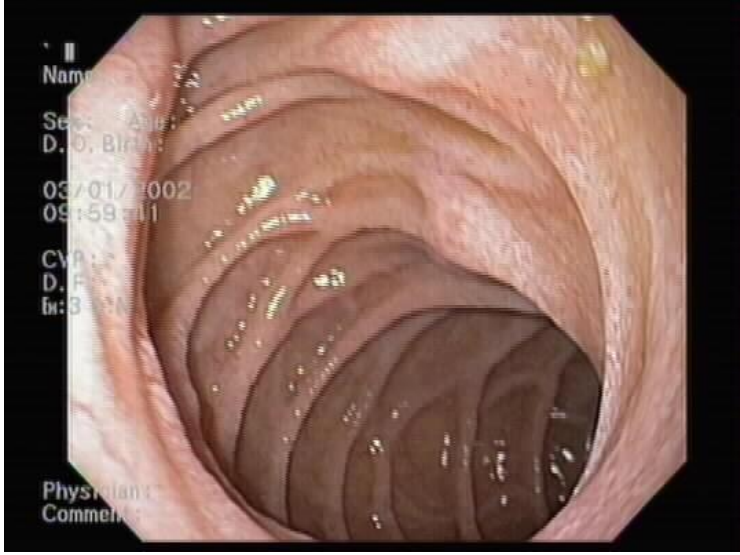


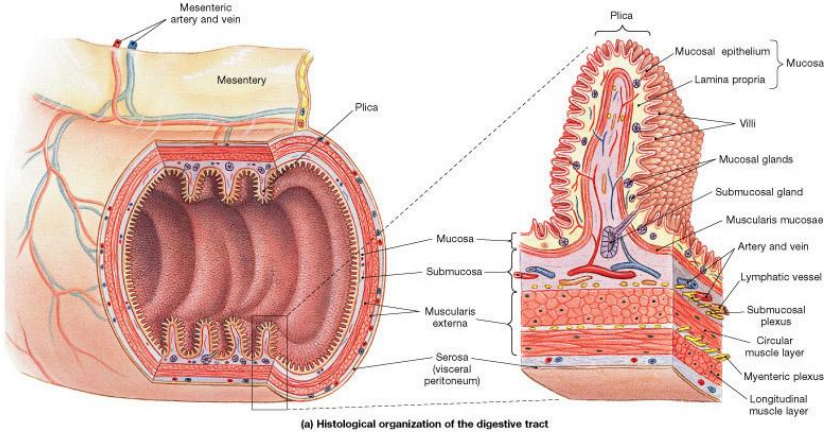
Fig. 22.6

Mesenteries - double sheets of peritoneum, surrounding and suspending portions of the digestive organs

- **Greater omentum** - "fatty apron", hangs anteriorly from stomach; double layer encloses fat
- **Lesser omentum** - between stomach and liver
- **Mesentery proper** - suspends and wraps the small intestine
- **Mesocolon** - suspends and wraps the colon, parts are
  - transverse mesocolon
  - sigmoid mesocolon

General Organization





(a) Histological organization of the digestive tract

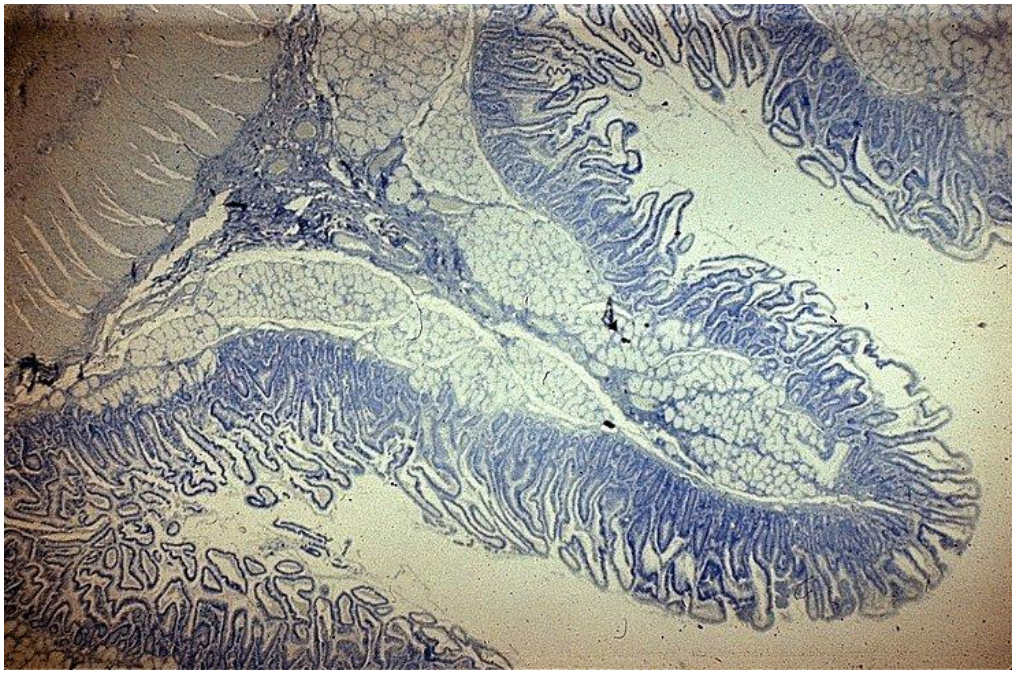
Structure of Small Intestinal Wall

Plicae circulares – circular pleats around the interior of the small intestine

Villi – minute finger-like projections, contain capillaries & lacteals

Microvilli – sub-microscopic size, projections on single cells

Function of all three?

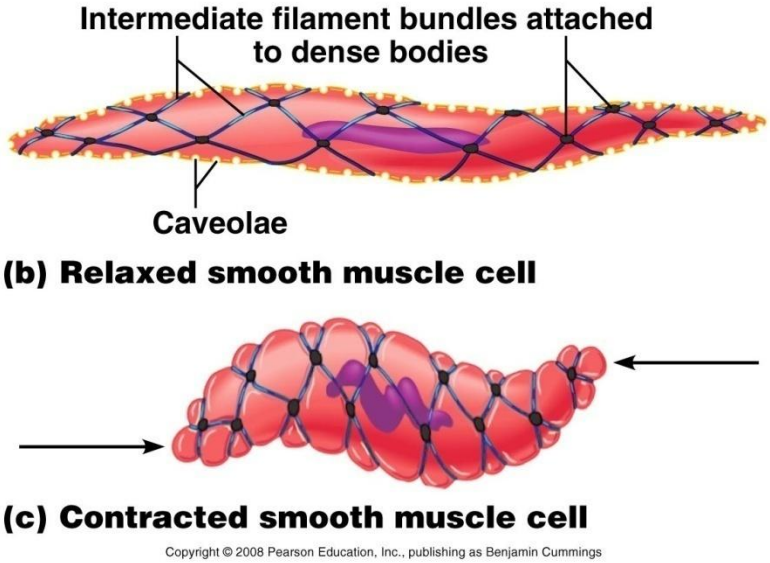


Crypts at bottom of villi—Cell regeneration (mitosis)

Glands—mucus, enzymes

Smooth Muscle, a review

- One nucleus
- Nonstriated
  - Actin and myosin present
- Slow, sustained contraction
- Communication
  - Varicosities
  - Gap junctions


Intermediate filament bundles attached to dense bodies
Caveolae
(b) Relaxed smooth muscle cell
(c) Contracted smooth muscle cell
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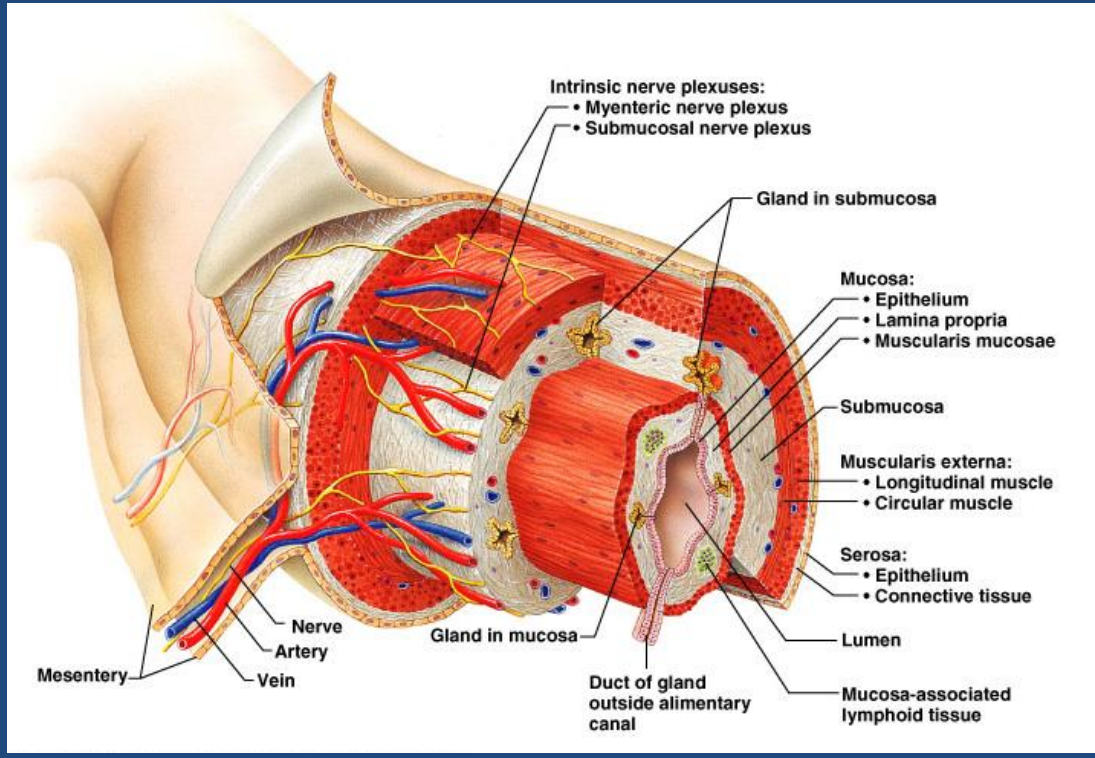
Histological Organization

Tube made up of four layers.

1. Mucosa
2. Submucosa
3. Muscularis externa
4. Serosa = Visceral Peritoneum

Modifications along its length as needed.



The 4 Layers of the Gut

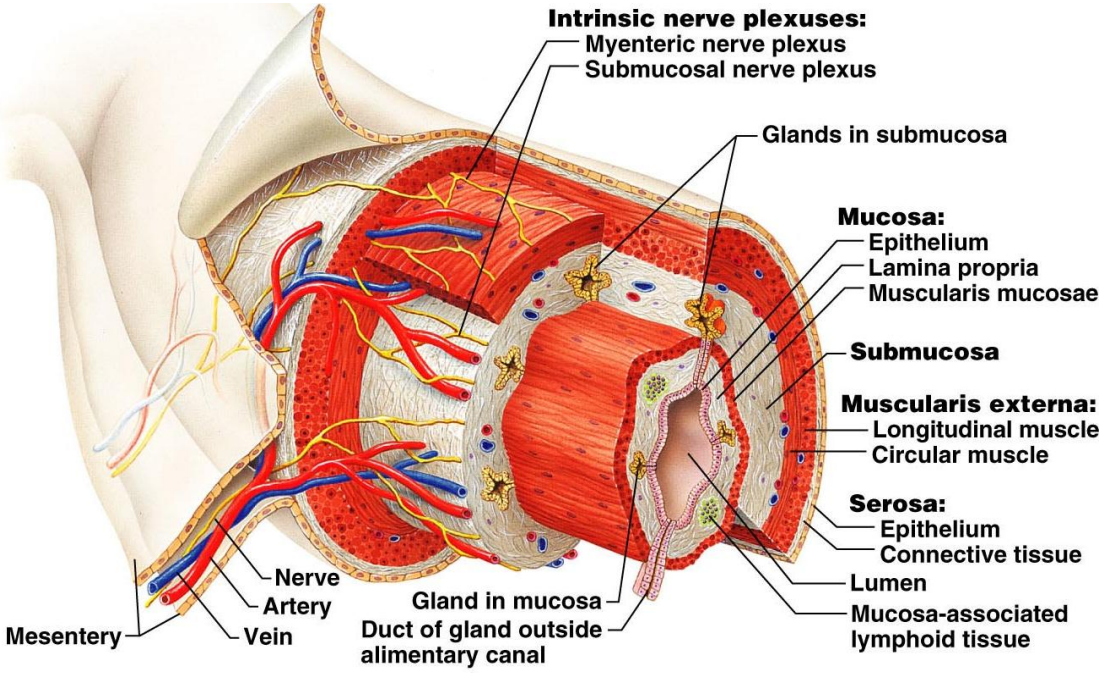
1) Mucosa

Epithelium - usually simple columnar epithelium with goblet cells; may be stratified squamous if protection needed, e.g., esophagus

Lamina propria – areolar connective tissue deep to epithelium

Muscularis mucosae -produces folds - **plicae** (small intestine) or **rugae** (stomach)

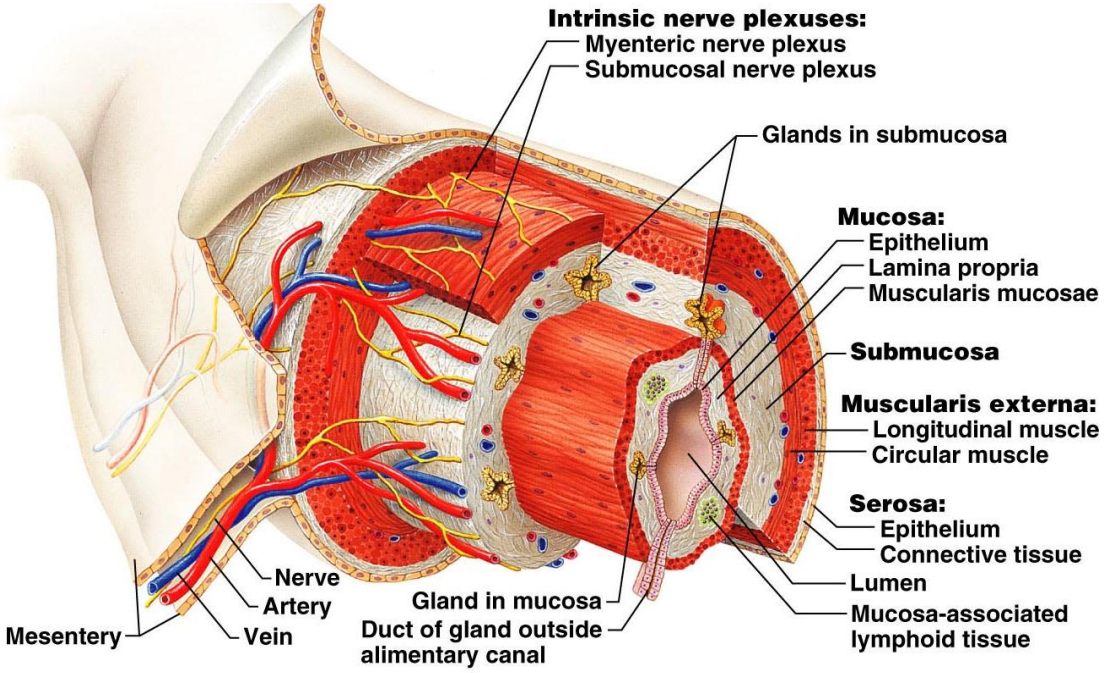
Fig 23.7



The 4 Layers of the Gut

2) **Submucosa** – made up of loose connective tissue
contains submucosal plexus and blood vessels

Fig 23.7

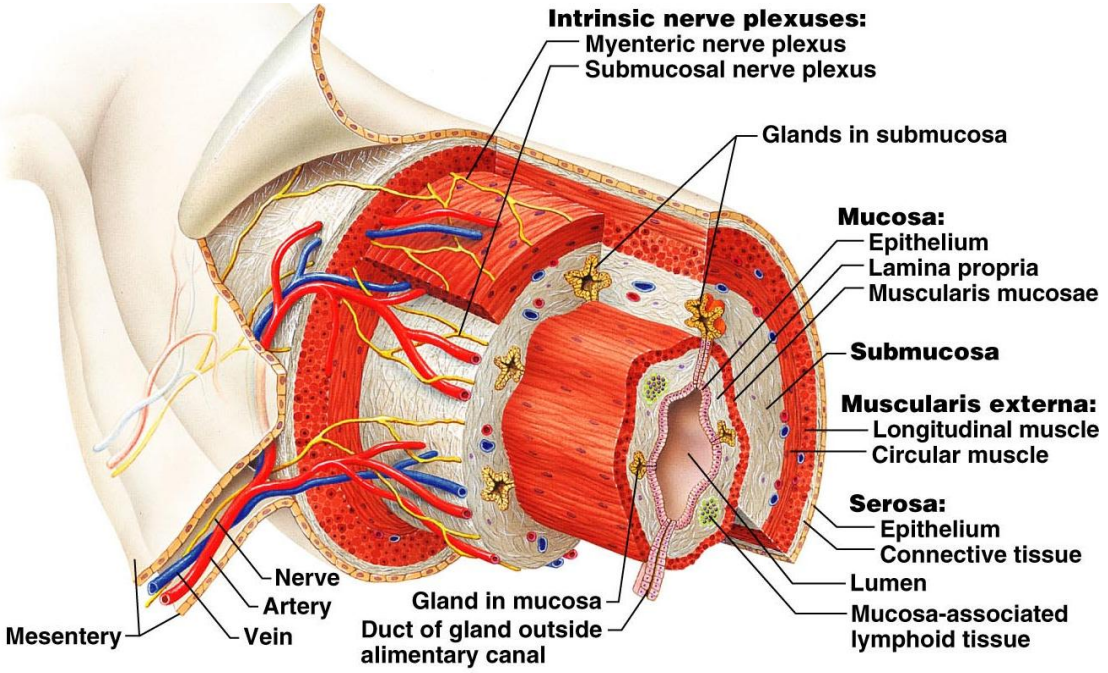


The 4 Layers of the Gut

3) **Muscularis externa** – smooth muscle, usually two layers
(controlled by the myenteric plexus; source of peristalsis)
-

inner layer: circular
outer layer: longitudinal

Fig 23.7

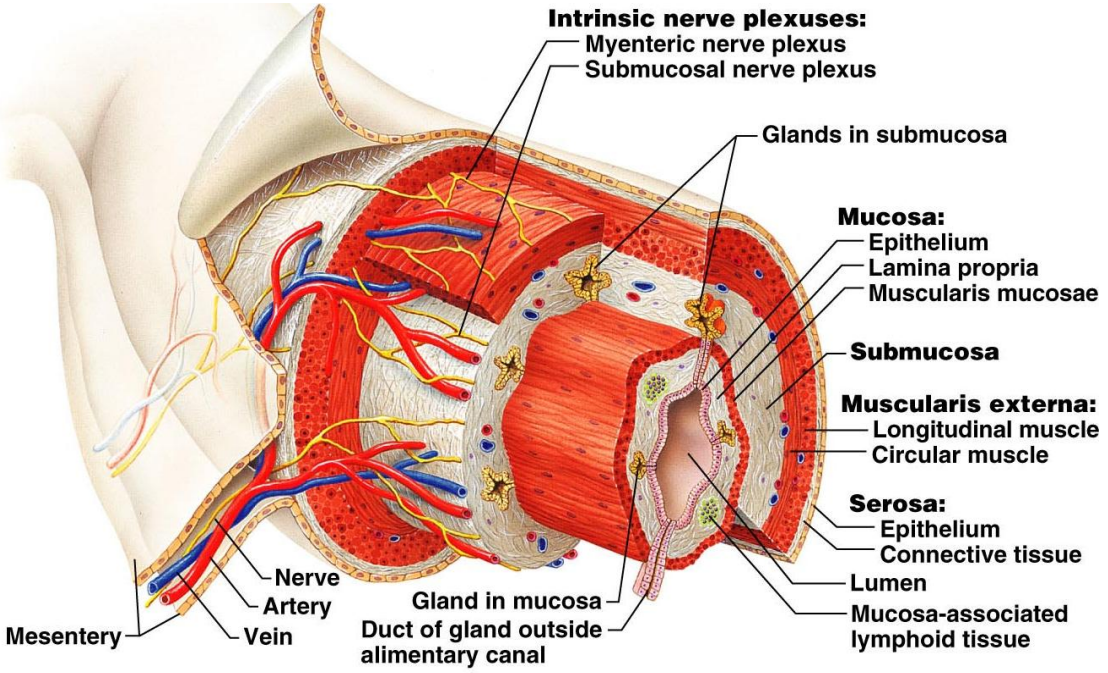


The 4 Layers of the Gut

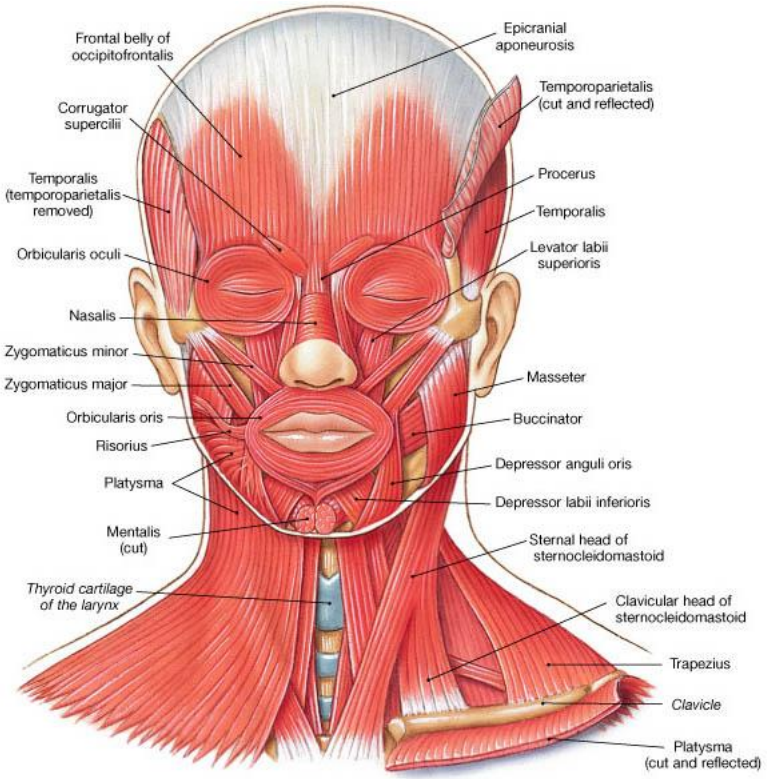
4) **Serosa**

visceral layer of mesentery (contiguous with the peritoneum) or adventitia depending on location

Fig 23.7

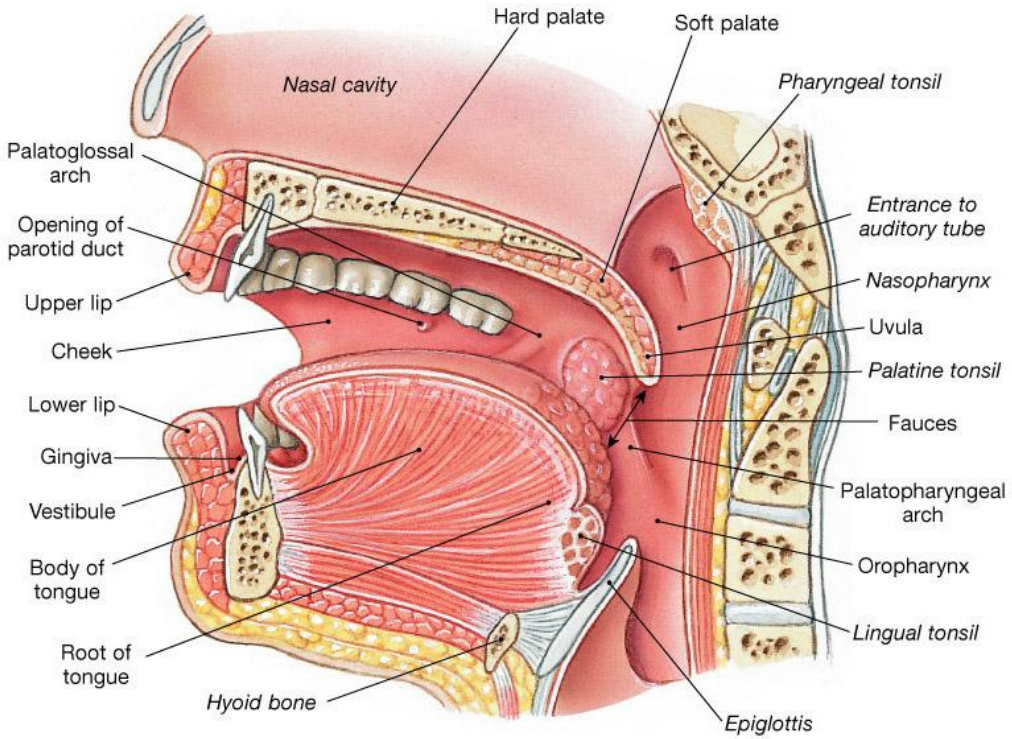


Repetitio est mater studiorum



(a) Anterior view

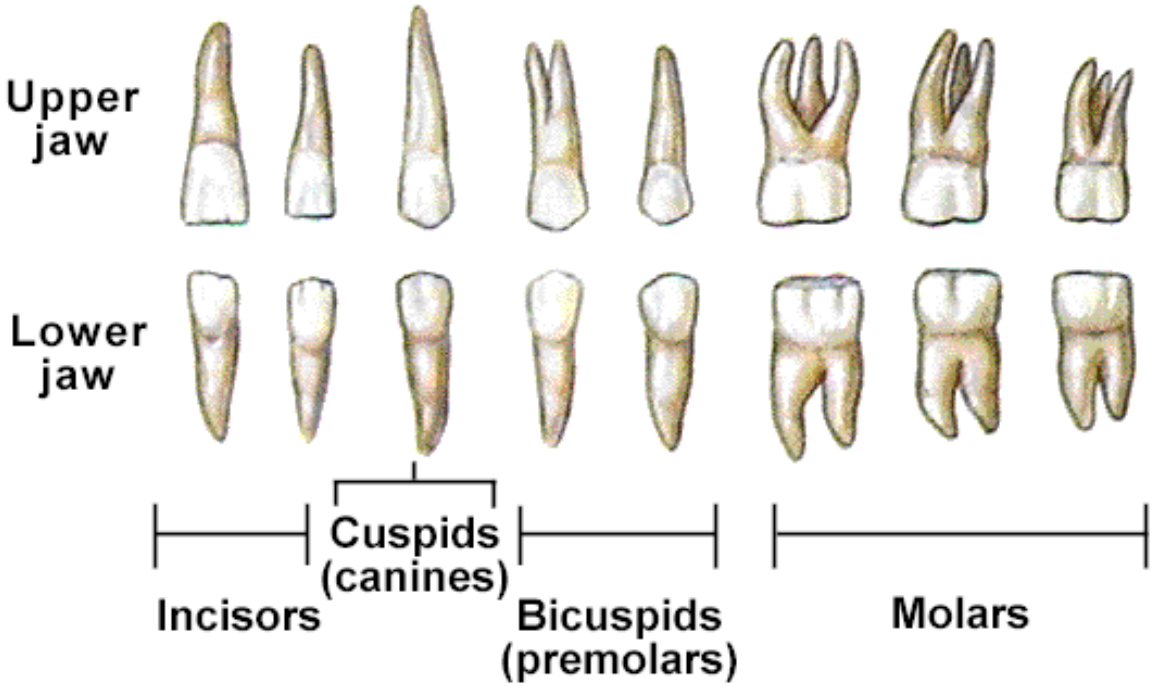
Oral Cavity



(a) Oral cavity, sagittal section

- AKA **buccal cavity** or mouth - lined with oral mucosa (type of epithelium ?)
- Lips = labia
  - Labial frenulum
- Hard and soft palates - form roof of mouth
- Tongue - skeletal muscle
  - Lingual frenulum
- Salivary glands - three pairs
- Teeth
- Fauces = opening to pharynx

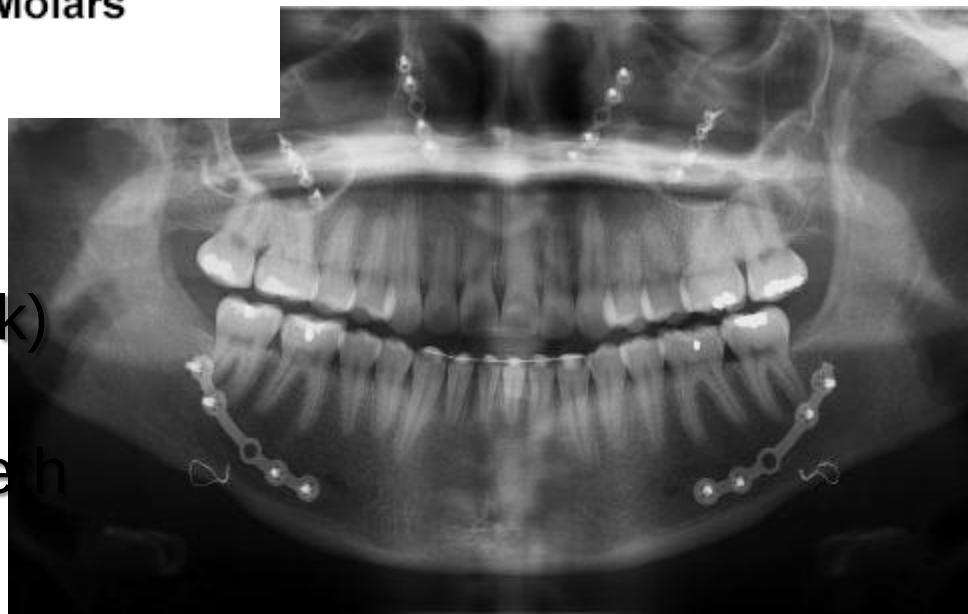
Types and Numbers of Teeth



Dental succession

Deciduous (1º, baby, milk) teeth - 20, replaced by

Permanent teeth - 32 teeth



Structure of Teeth

Fig 23.14

Crown - exposed surface of tooth

Neck - boundary between **root** and crown

Enamel - outer surface

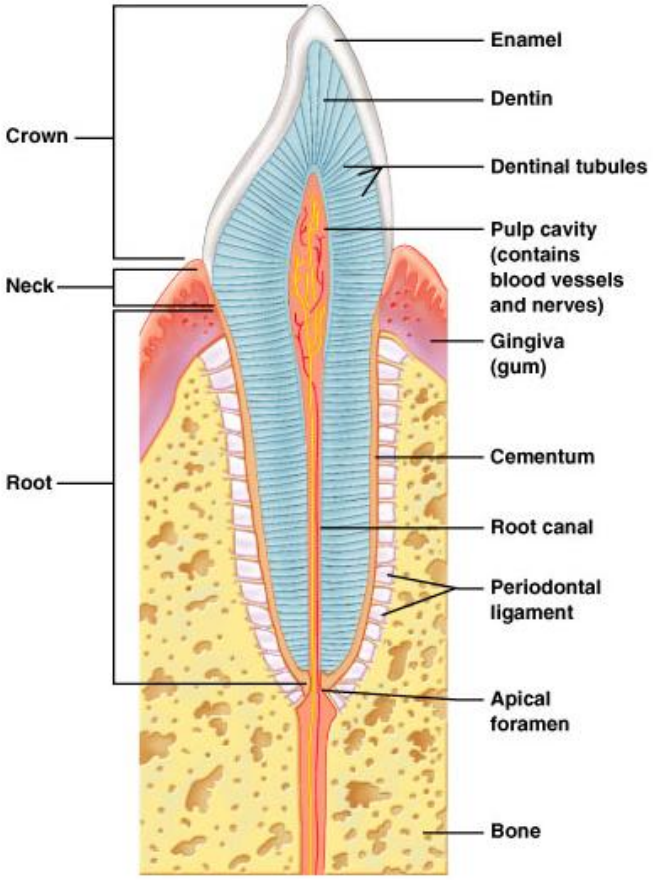
Dentin – bone-like, but noncellular

Pulp cavity - hollow with blood vessels and nerves

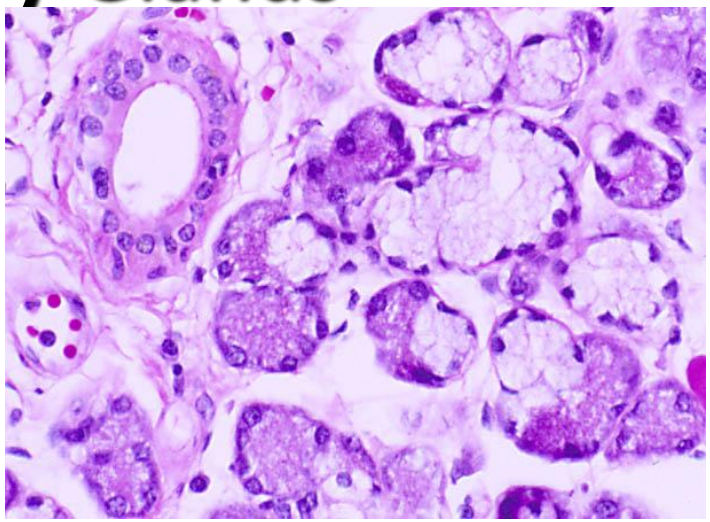
Root canal - canal length of root

Gingival sulcus - where gum and tooth meet

Periodontal Ligament

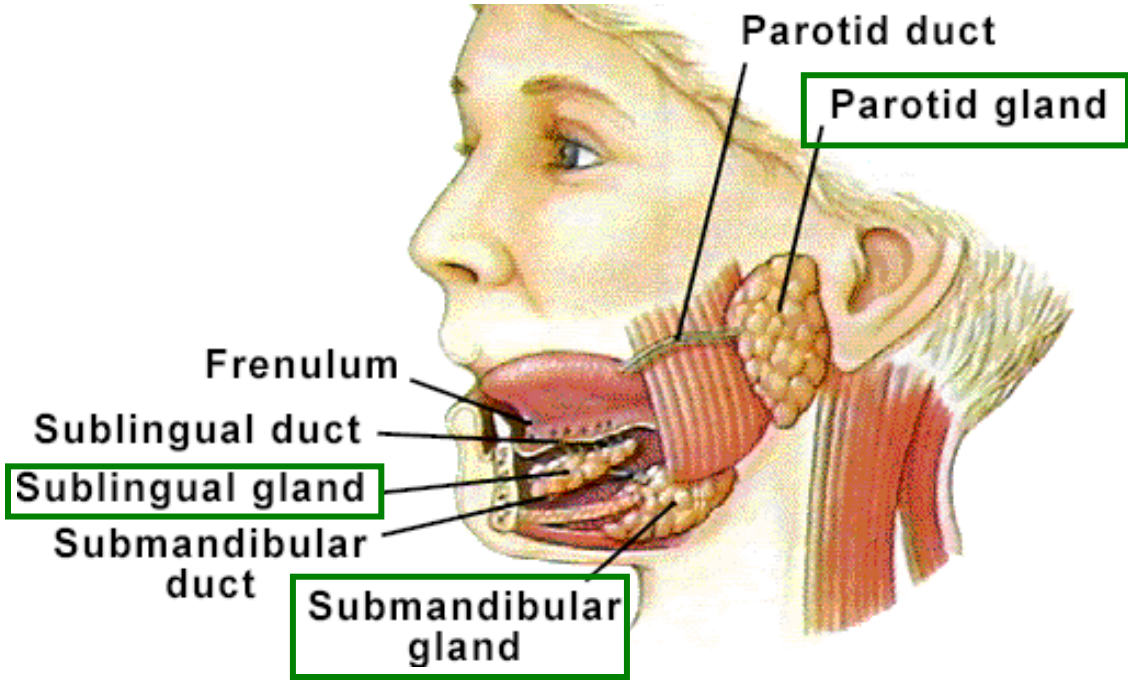


Three pairs of Salivary Glands

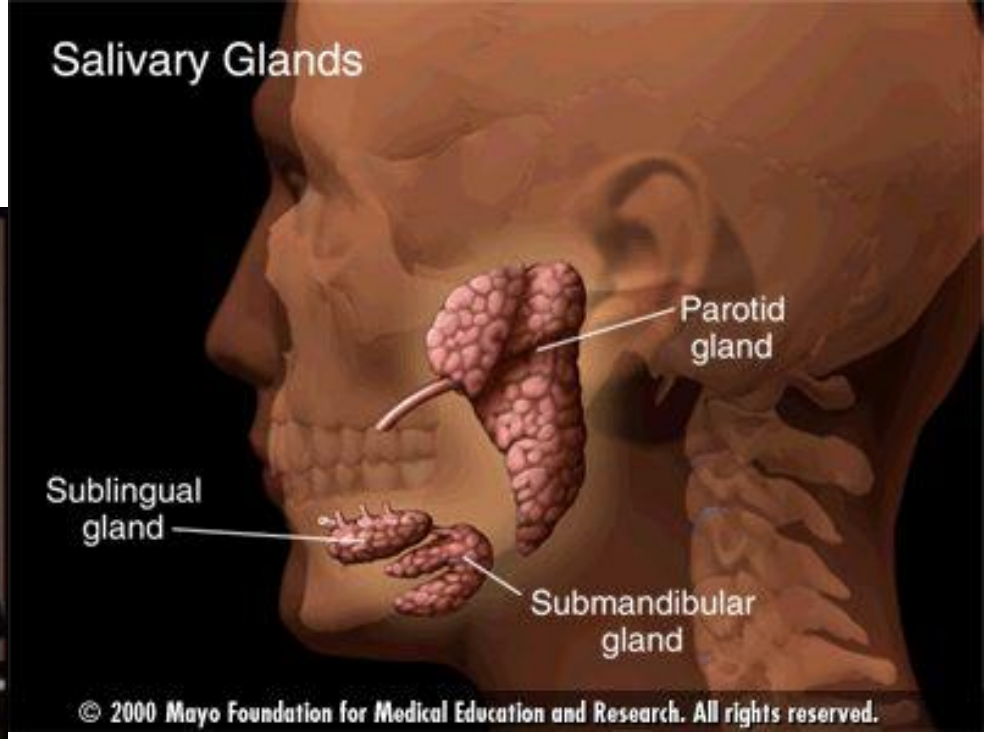


1-1.5 L / day for
digestion (?)
lubrication (swallowing) moistening (tasting)

- **Parotid** – lateral side of face, anterior to ear, drain by parotid duct to vestibule near 2nd upper molar
- **Submandibular** – medial surface of mandible – drain near lingual frenulum drain posterior to lower molars
- **Sublingual** – in floor of mouth - drain near lingual frenulum



Mumps


Salivary Glands
Parotid gland
Sublingual gland
Submandibular gland
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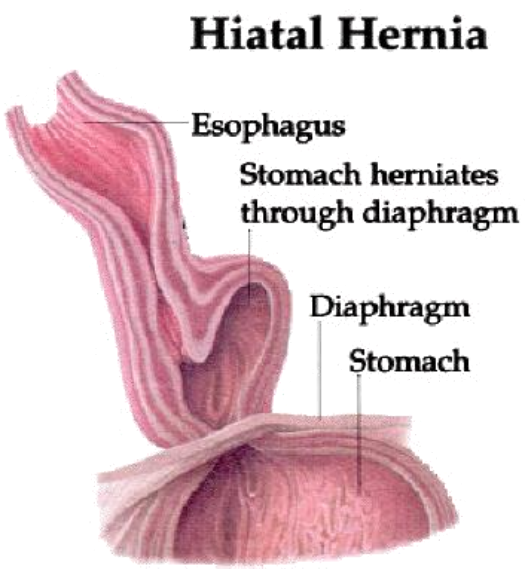
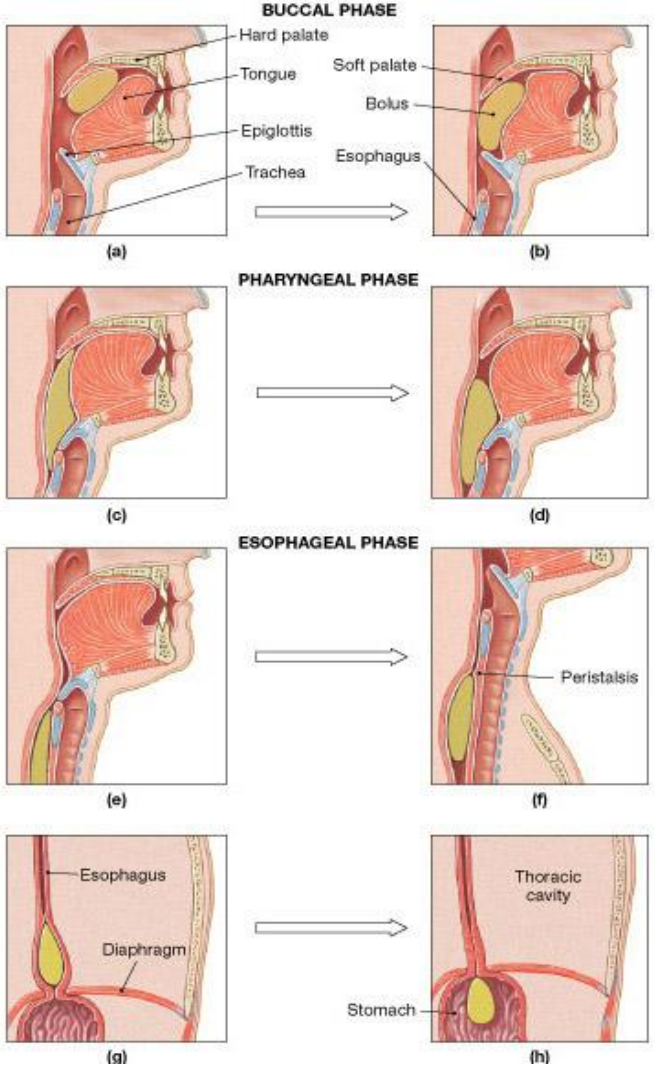
Swollen, painful parotid salivary glands (parotitis) on one or both sides of the face
Etiology: Mumps virus (Myxovirus)
Fever and sometimes orchitis, pancreatitis etc.
About 1/3 of infected people do not show symptoms

Effective vaccine (MMR) since 1967

Esophagus

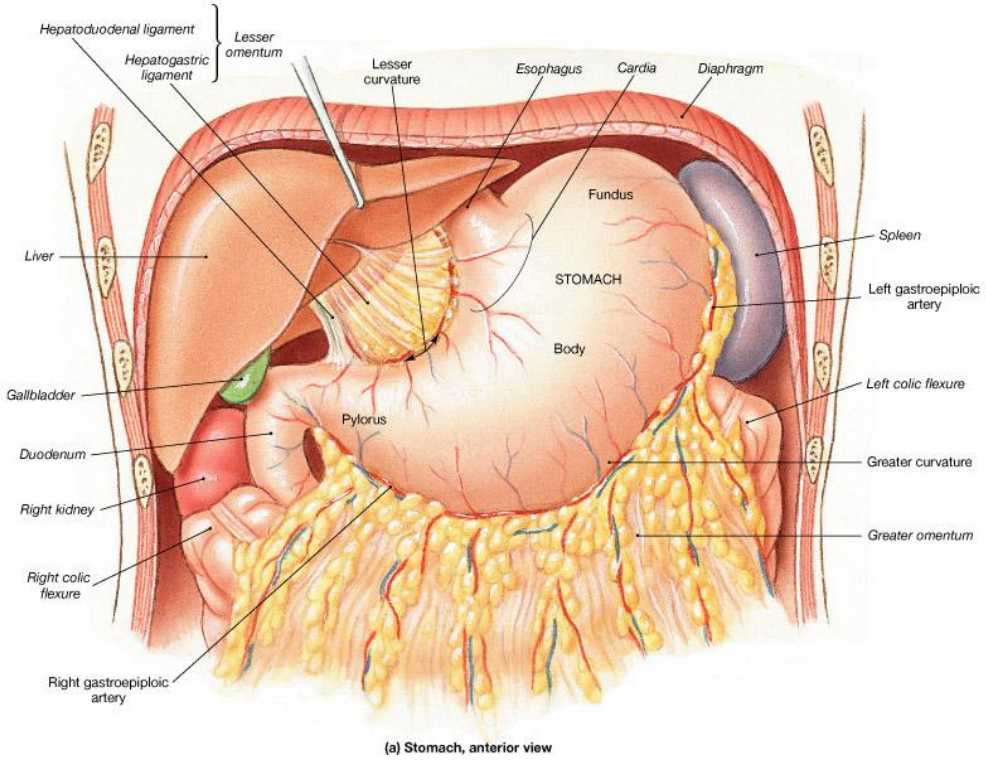
- Lined with noncornified stratified squamous epithelium
- Food boluses propelled by peristalsis of both skeletal and smooth muscle (gravity, too)
- Hiatus; lower esophageal sphincter
- GERD





Stomach

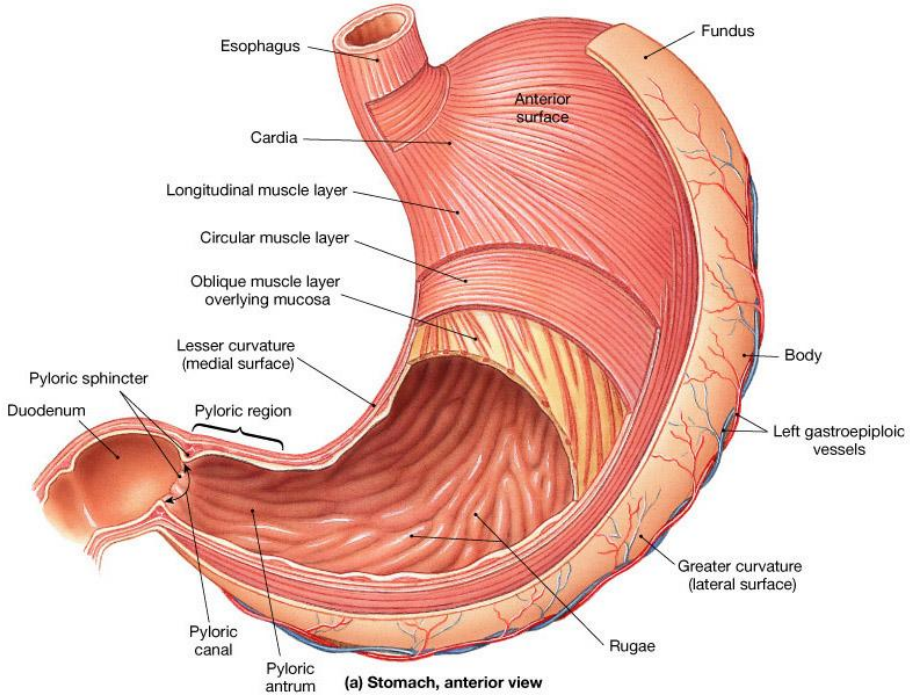
- Cardiac Sphincter (?)
- Cardia
- Fundus
- Body
- Pylorus
- Pyloric sphincter
- Greater and Lesser Curvatures
- Greater Omentum

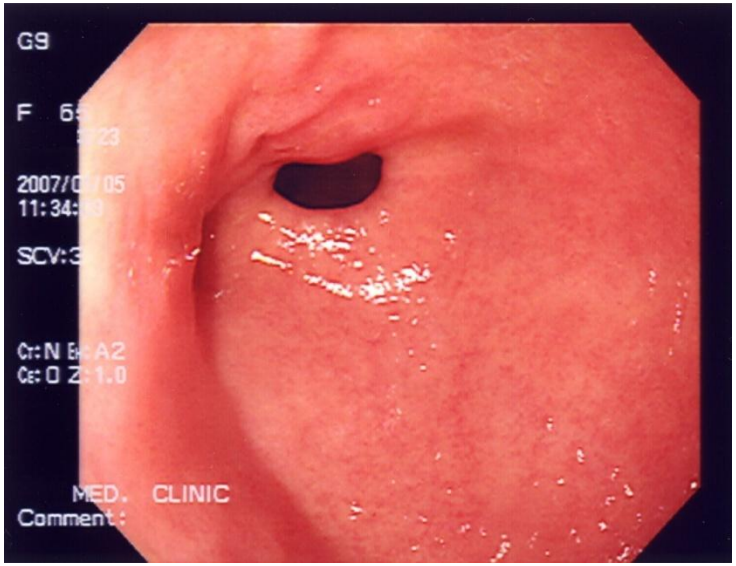


(a) Stomach, anterior view

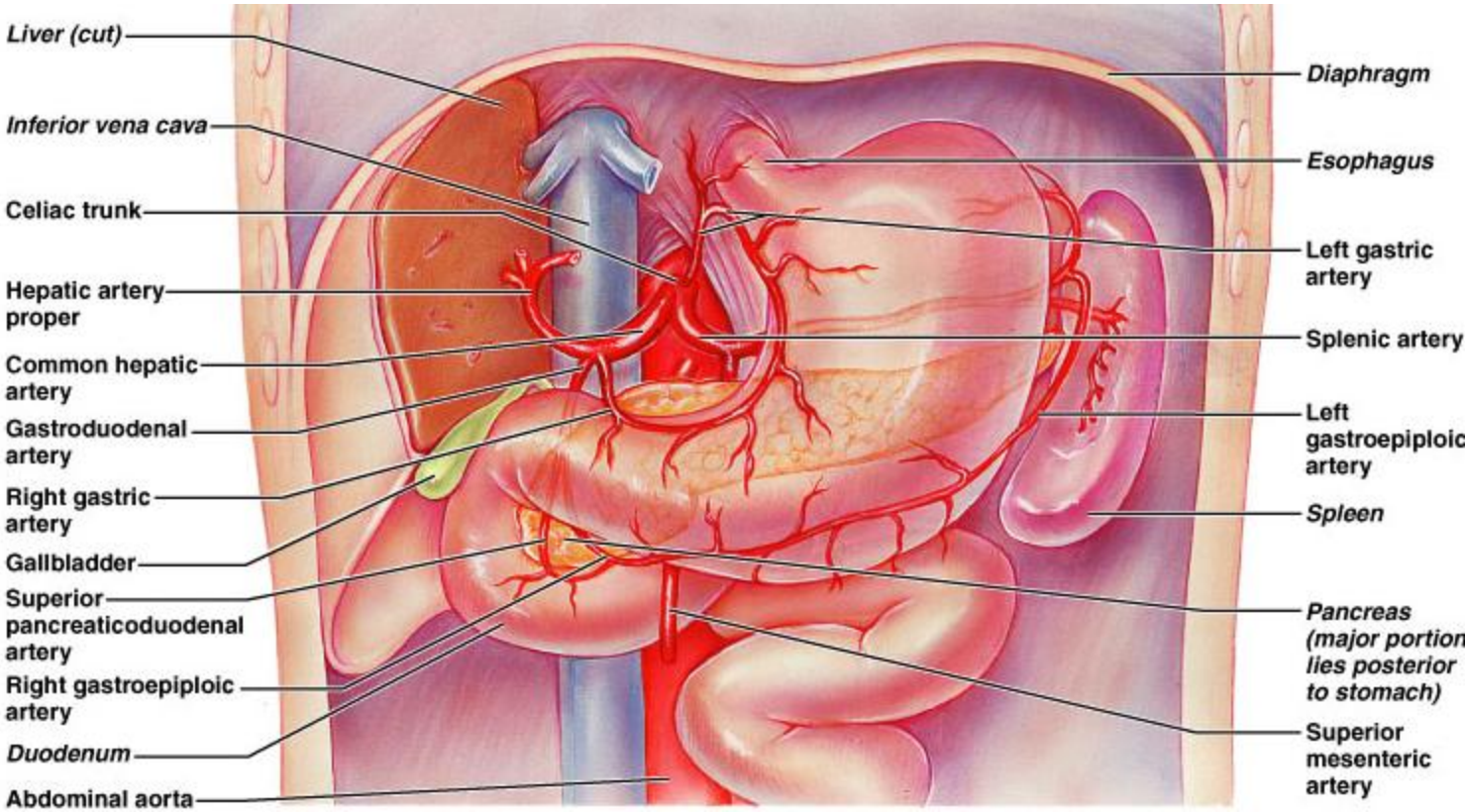
Stomach

- Rugae or Rugal Folds
- Pylorus
- Pyloric sphincter





Circulation



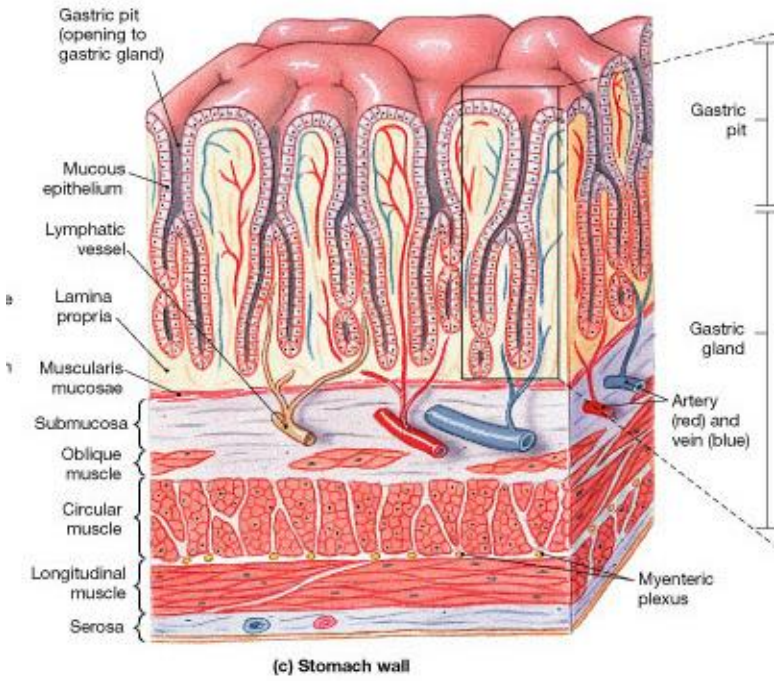
Histology of Stomach

Type of epithelium lining stomach?

Gastric pits – shallow pits, external half rapidly reproduces for replacement

Gastric glands – deep in lamina propria, *3 types of cells*

1. **Parietal cells (produce HCl and intrinsic factor B_{12})**
2. **Chief cells (produce pepsinogen)**
3. **Enteroendocrine cells – G cells** (several hormones including gastrin which stimulates both parietal and chief cells)

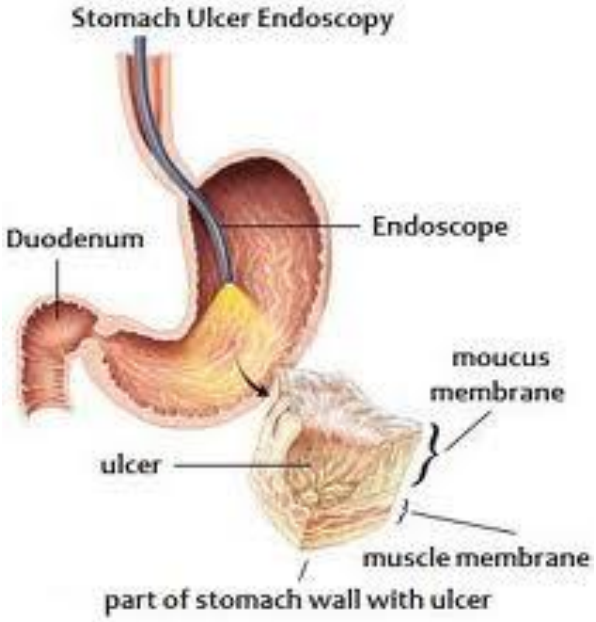


(c) Stomach wall

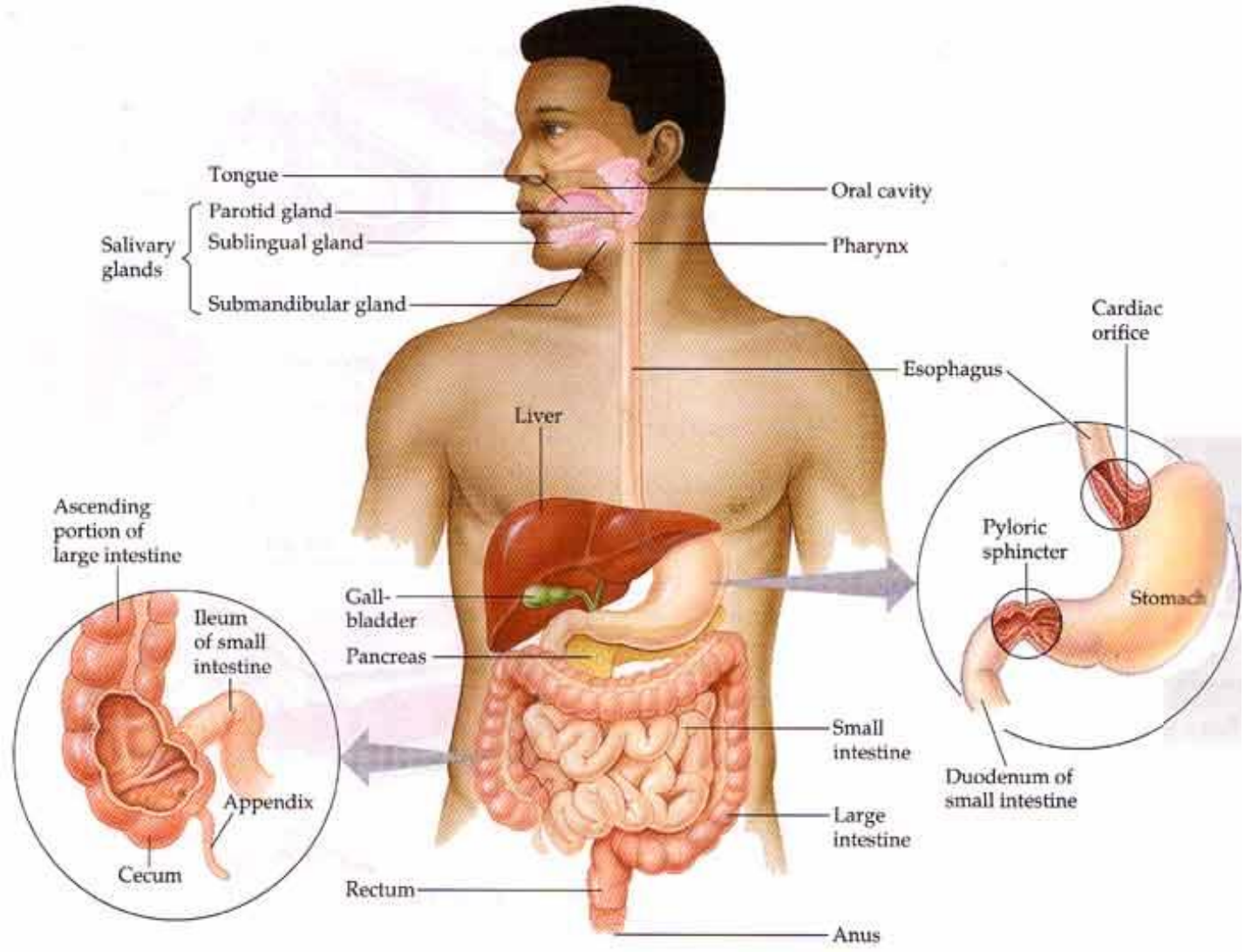
Ulcers

- Mucosal erosion of stomach or duodenum
- GERD
- NSAIDs
- *Helicobacter pylori*
- Stress??
- Dx by esophagogastroduodenoscopy

http://www.youtube.com/watch?v=hm1nEPHxJ0E



Review:


Tongue
Oral cavity
Parotid gland
Salivary glands
Sublingual gland
Pharynx
Submandibular gland
Cardiac orifice
Esophagus
Liver
Ascending portion of large intestine
Pyloric sphincter
Gall-bladder
Stomach
Ileum of small intestine
Pancreas
Small intestine
Duodenum of small intestine
Appendix
Large intestine
Cecum
Rectum
Anus